EFFECTS OF TERNARY MIXTURE OF CHALCOGENS ON THE $Fe_{1.02}Se$ SUPERCONDUCTING PROPERTIES

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The recent discovery of unconventional superconductivity in a large family of iron-based pnictide and chalcogenide compounds [1,2] may lead to the better understanding of the mechanisms of high temperature superconductivity. The crystal structure of the Fe-based compounds consists of Fe pnictide or Fe chalcogenide layers responsible for superconductivity, usually separated by layers of other atoms. This work aims to study the anion mixing effect on the crystal structure and superconducting properties of FeSe-based compounds taking into account that the chalcogen ions have not only different ionic radii but also different electronegativities and, therefore, may form chemical bonds with different covalency/ionicity ratio.

Four series of polycrystalline samples with nominal compositions $Fe_{1.02}Te_ySe_{1-y-x}S_x$ where (y = 0.3, 0.4, 0.5, 0.6) and (x = 0, 0.1, 0.2, 0.3, 0.4, 0.5) were prepared by a solid state reaction method. The synthesized samples have been studied by means of X-ray diffraction, electrical resistivity and magnetic susceptibility measurements.

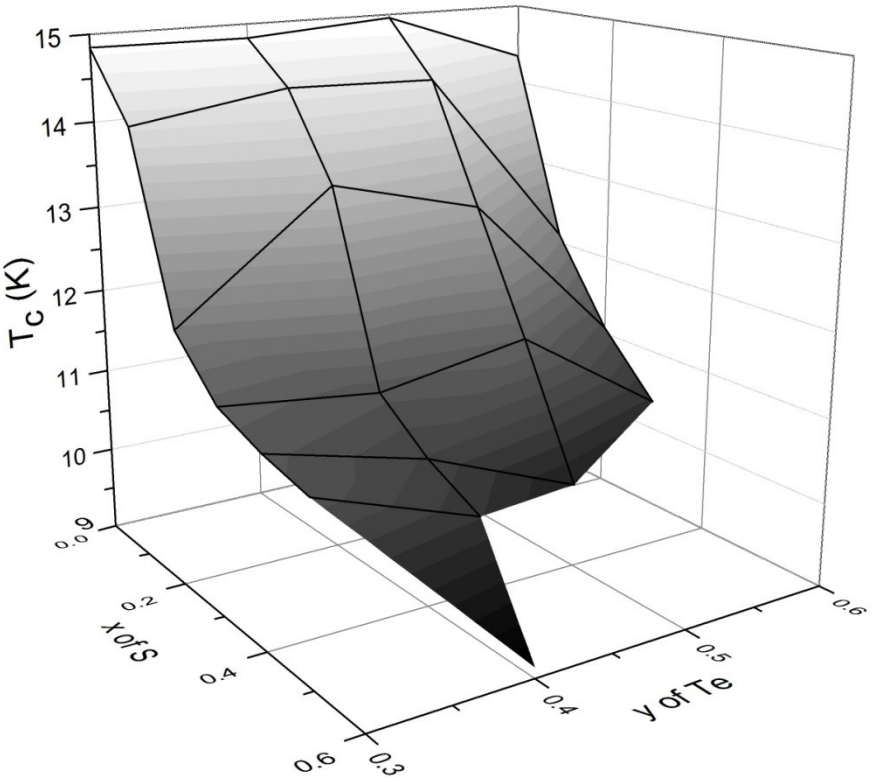

Fig. 1. Concentration dependence of the critical temperature T_c in the $Fe_{1.02}Te_ySe_{1-y-x}S_x$ compounds.

The substitution of S for Se keeping the constant tellurium concentrations $y = 0.3$, 0.4, 0.5, 0.6 in $Fe_{1.02}T_ySe_{1-y-x}S_x$ was found to expand the crystal lattice in all samples despite the lower ionic radius of sulfur in comparison with selenium [3]. The expansion of the unit cell with increasing sulfur content may be ascribed to the softening of the lattice due to the growing amount of more ionic Fe-S bonds and weakening of the van der Waals interactions between chalcogen layers. Together with the lattice expansion the substitution is observed to reduce the critical temperature of superconductivity in all series (Fig. 1). The results of the magnetization measurements have shown that the materials exhibit bulk superconductivity and the shielding volume fractions for all the samples decreases with increasing sulfur content. The results obtained in the present work show that the variation of S, Se and Te concentrations in the ternary chalcogen mixture can be used to control the lattice, superconducting and magnetic properties of iron-chalcogen based superconductors.

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MAGNETIC AND MAGNETORESISTIVE PROPERTIES OF FeMn/FeNi/Co-Al_2O_3/FeNi FILMS

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Magnetic films containing exchange-coupled antiferromagnetic and ferromagnetic layers have been a subject of many studies devoted to the development of magnetic sensors [1]. The present research is aimed to develop a medium with optimal values of the anisotropic magnetoresistance (AMR), internal magnetic bias and high sensitivity to external magnetic field. For this purpose, multilayered FeMn/FeNi films were used. In order to reduce the exchange bias field and, consequently, increase the sensitivity granular interlayer was introduced into the permalloy layer. Thus the objects of the study were $Ta(5)/Fe_{20}Ni_{80}(5)/Fe_{50}Mn_{50}(20)/Fe_{20}Ni_{80}(5)/Co_{40}-(Al_2O_3)_{60}(L)/Fe_{20}Ni_{80}(40)/Ta(5)$ (in parentheses thickness in nm is specified) planar structures.

Two series of the samples were obtained by magnetron sputtering of one-component and alloyed targets onto glass substrates at presence of the external magnetic field oriented parallel to the films surface. Samples of the first one were as-deposited (A-samples), whereas samples of the second series (B-samples) were sub-